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On the cost of misperception: General results and behavioral applications ☆

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Abstract

In a choice model, we characterize the loss induced by misperceptions of payoff-relevant parameters across a distribution of decision problems. When the agent cannot avoid misperceptions but has some control over the distribution of errors, we show that strategies that minimize loss from misperception exhibit systematic biases, akin to some documented in the behavioral and psychological literatures. We include illusion of control, order effect, overprecision, and overweighting of small probabilities as illustrative examples.

JEL classification: D8; D9

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1. Introduction

Within economic discourse, the idea that the human mind is imperfect and that some information is necessarily lost during any decision process dates back at least to Simon (1955). Under this premise, an agent faces, apart from the standard action choice, a problem of error management. In economic decision making, some mistakes in perception of payoff-relevant parameters are costlier than others, and this asymmetry has an impact on the frequency of different types of perception errors. In this paper, we relate error management to known observed behavioral biases. In order to understand the direction of biases arising under second-best perception strategies, we need first to understand the associated costs of under- or over-estimating payoff-relevant parameters.

Our agent first receives some statistical information on a state of nature which can be either high or low, and this information translates into an objective belief p that the state is high. In a choice stage, she recalls this information imperfectly and ends up with a subjective belief q that the state is high. She then chooses an action that is optimal under her subjective belief q within a fixed choice set. Due to belief distortion, her choice may differ from the optimal one. We ask how large is the payoff loss incurred from the misperception of p for q.

We derive a simple and intuitive characterization of the loss from misperceiving p as q. This loss can be expressed as an integral formula that depends only on the second derivative v'' of the value function. The value function $v(p)$, for each probability p of the high state, specifies the payoff of the optimizing agent who has correct perception. This characterization makes the loss from misperception simple to compute in several applications in which the direct computation is cumbersome.

Equipped with this loss characterization, we study a class of error-management problems in which the agent chooses a distribution of perception errors that performs well across all decision problems that she encounters in her environment. We follow principles from the ecological rationality literature, in that our agent is unable to reoptimize the perception strategy in each encountered decision problem separately but, instead, must choose a perception heuristic that fits her environment.[1]

The model is as follows. Based on all available information, the agent forms an objective probability p of a high payoff state. She then memorizes a probability m in the perception stage, and recalls a perturbed value $q = m + \varepsilon$ in the choice stage, where ε is a noise term with symmetric density. Then, she encounters a random decision problem drawn from her environment and chooses an action that she perceives as optimal under her belief q and the encountered utility function.

One feasible perception strategy is to memorize the true probability value. Under such a strategy, the recalled probability is in expectation equal to the true one. It turns out, however, that this unbiased perception strategy is generically suboptimal, and the agent benefits from memorizing m distinct from the true probability p.

We characterize the direction of the optimal perception bias based on monotonicity properties of the second derivative v'' of the value function. When v'' is decreasing in a neighborhood of the true observed probability, we show that the agent memorizes a probability higher than the true one and thus exhibits an upward perception error bias. When v'' is decreasing, her memory exhibits a downward bias. In applications with Gaussian distributions of payoffs, the value function

1 See Simon (1956) and Gigerenzer and Todd (1999) on ecological rationality.